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# PATENT ABSTRACTS OF JAPAN

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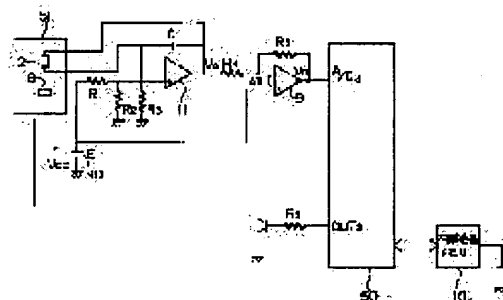
(72)Inventor : TAKAYANAGI YOSHIAKI

## (54) LIQUID JET RECORDER

(57)Abstract:

PURPOSE: To conduct an accurate temperature control of a liquid jet recording head by using a low-cost temperature sensor.

CONSTITUTION: As a temperature detection element 2, a low-cost element, such as a diode or a snaking pattern of aluminum or the like having a relatively large resistance change coefficient to a temperature change, is provided. When the temperature control of a head is conducted by using the temperature characteristics of such an element, an intrinsic variation of the temperature detection circuit is previously written in a non-volatile memory 110, and based on this value, the detection output of the temperature detection element 2 is corrected.



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CLAIMS

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[Claim(s)]

[Claim 1] A fluid injection recording device with the removable recording head which has the energy generation element which generates the energy used in order to be prepared corresponding to the delivery and this delivery for carrying out the regurgitation of the record liquid characterized by providing the following and to carry out the regurgitation of the aforementioned record liquid, and a temperature sensing element for detecting temperature. A nonvolatile storage means to hold the property of the aforementioned temperature sensing element. An amendment means to rectify the detection output of the aforementioned temperature sensing element based on the property concerned.

[Claim 2] The aforementioned energy generation element is a fluid injection recording device according to claim 1 characterized by being the electric thermal-conversion element which generates the heat energy which makes the aforementioned record liquid produce film boiling.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] Especially this invention is applied to the fluid injection recording device which comes to use an electric thermal-conversion object for the regurgitation energy generation means of the drop for record about a fluid injection recording device, and is suitable.

[0002]

[Description of the Prior Art] Since liquid deliveries, such as an orifice for carrying out the regurgitation of the drop of the liquid for record (ink), can be arranged with high density, this kind of fluid injection recording head can carry out record of high resolution. The progress of technology and the improvement in reliability in that miniaturization overall as a recording head is also easy and the latest semiconductor field can utilize the advantage of remarkable IC technology or micro processing technology more than enough. According to long-picture-izing and shape[ of a field ]-izing (two-dimensional-izing) being easy etc., the formation of a multi-nozzle and high-density-assembly-izing are easy, and, moreover, the productivity at the time of mass production method attracts attention especially as what is improved at a low price by manufacture costs.

[0003] However, this kind of fluid injection recording head has a relation between the diameter of drops of temperature and ink, regurgitation speed, etc., and these affect picture concentration and have the feature of influencing record grace.

[0004] In view of such a point, as conventionally shown in drawing 1, it is a head 201. Highly precise thermistor 203 It prepares and is this thermistor 203. It is a change in resistance A/D, such as a microcomputer 206, A conversion terminal detects and it is a recording head 201. Keeping-warm heater 202 for heating and keeping it warm Power was controlled. In addition, it sets to drawing 1 and is 204. A partial pressure resistor and 205 It is a transistor for a switch for turning on / turning off the keeping-warm heater 2.

[0005]

[Problem(s) to be Solved by the Invention] However, the temperature-control method which requires temperature sensing elements, such as the conventional highly precise thermistor, makes the manufacturing cost of a head expensive, and when considering especially a recording head or the recording head (a head cartlidge is called below) of the gestalt which unified this and the ink source-of-supply slack ink tank as the composition which enabled it to detach and attach easily on the main part of equipment, and made exchange possible, it serves as a trouble.

[0006] Even if a cheap temperature sensor with variation is used for the purpose of this invention in view of this point, it is to enable it to give exact temperature.

[0007]

[Means for Solving the Problem] Therefore, the energy generation element which generates the energy used in order that this invention may be prepared corresponding to the delivery and this delivery for carrying out the regurgitation of the record liquid and may carry out the regurgitation of the aforementioned record liquid, It is characterized by having a nonvolatile storage means to hold the property of the aforementioned temperature sensing element, and an amendment means to rectify the detection output of the aforementioned temperature sensing element based on the property concerned, in a fluid injection recording device with the removable recording head which has a temperature sensing element for detecting temperature.

[0008]

[Function] In case according to this invention cheap things, such as meandering patterns, such as comparatively large aluminum of resistance rate of change, are prepared in the temperature sensing element of a head to diode or a temperature change and the temperature control of a head is performed using the temperature characteristic of such an element, it becomes possible to abolish the error of temperature detection by the temperature detector's writing beforehand the variation which it has peculiar in non-volatile memory, and rectifying the detection output of a temperature sensing element based on this.

[0009]

[Example] Hereafter, with reference to a drawing, this invention is explained in detail.

[0010] The example of composition of the fluid injection recording device (ink-jet recording device) which drawing 2 requires for the 1st example of this invention, and drawing 3 are the example of composition of the recording head, and drawing 4 (a). And (b) The example of composition of a heater board employable as a component of the recording head shown in drawing 3 is shown.

[0011] First, in drawing 2, 14 is a head cartlidge and makes one the recording head constituted using the heater board later mentioned per drawing 3 and drawing 4, and an ink source-of-supply slack ink tank. This head cartlidge 14 presses down, and is being fixed by the member 41 on carriage 15, and these can reciprocate to a longitudinal direction along with a shaft 21. The ink breathed out from the recording head sets a recording head and a very small interval, reaches the record medium 18 which had the recording surface regulated by the platen 19, and forms a picture on a record medium 18.

[0012] The regurgitation signal according to image data is supplied to a recording head from a proper data source of supply through the terminal 4 (drawing 4) combined with a cable 16 and this. A head cartlidge can prepare 1 or plurality (drawing two pieces) according to the ink color to be used.

[0013] In addition, in drawing 2, the carriage motor for 17 making carriage 15 scan along with a shaft 21 and 22 are wires which transmit the driving force of a motor 17 to carriage 15. Moreover, 20 is a feed motor for combining with a platen roller 19 and making a record medium 18 convey. Moreover, 122 It is a reference-temperature sensor used as the criteria for being prepared in a part with the proper main part of equipment, and rectifying the temperature sensor mentioned later. This reference-temperature sensor 122 It is arranged at the proper part which is not influenced of a temperature up inside the plane, and the monitor of the ambient temperature is carried out.

[0014] Drawing 3 is the example of composition of the recording head concerning this example. Here, 1 is a heater board, and on a silicon substrate, the electric thermal-conversion object (regurgitation heater) 5 and the wiring 6 of aluminum which supplies power to this are formed by membrane formation technology, and it changes. And a fluid injection recording head is constituted by pasting up the top plate 30 which prepared the septum for forming the liquid route (nozzle) 25 of the liquid for record to this heater board 1.

[0015] The liquid for record (ink) is supplied to the common liquid room 23 from the feed hopper 24 prepared in the top plate 30, and is led in each nozzle 25 here. And if a heater 5 generates heat by energization, foaming will arise in the ink filled in the nozzle 29, and an ink drop will be breathed out from a delivery 26.

[0016] Drawing 4 (a) And (b) They are the plan of the heater board concerning this example, and its elements on larger scale, respectively.

[0017] This drawing (a) Setting, 3 is the regurgitation heater section. 4 is a terminal and is connected with the exterior by wirebonding. 2 is a temperature detection means slack temperature sensor, and is formed in the regurgitation heater section 3 according to the same membrane formation process as regurgitation heater section 3 grade. This drawing (b) This drawing (a) It is the enlarged view of the portion B containing the sensor 2 which can be set, and 8 is a heating means slack keeping-warm heater for heating a head.

[0018] Like other portions, since the sensor 2 is formed according to the same membrane formation process as a semiconductor, it is very highly precise, and it can be created with material from which conductivity changes according to temperature, such as aluminum which is the component of other portions, titanium, a tantalum, 5 tantalum oxide, and niobium. For example, the material and the tantalum which can be arranged among both among these in order that the material which can use aluminum for an electrode, and titanium may raise the adhesive property of the exoergic resistive layer and electrode which constitute an electric thermal-conversion element are the material which can be arranged in the upper part, in order to raise the cavitation-proof nature of the protective layer on an exoergic resistive layer. Moreover, in order to make line breadth thick in order to make variation in a process into smallness, and to lessen influence of wiring resistance etc., high resistance-ization is attained as a meandering configuration.

[0019] Moreover, the keeping-warm heater 8 is the same material (for example, HfB<sub>2</sub>) as the exoergic resistive layer of the regurgitation heater 5 similarly. Although it can use and form, you may form using the other materials which constitute a heater board, for example, aluminum, a tantalum, titanium, etc.

[0020] Next, the mode of the temperature control of the recording head concerning this example is explained.

[0021] In the recording head shown in drawing 3 concerning this example, since the temperature sensor 2 is provided in the ends of the heater board 1 as shown in drawing 4, the distribution state of the substrate temperature in the array direction of a nozzle 25 can be grasped from the output of those temperature sensors. Moreover, since the heater 8 for keeping warm is formed near the temperature sensor 2, the speed of response of detection of change of the temperature by heating is high.

[0022] Drawing 5 shows the outline of the example of 1 composition of the control system concerning this example.

[0023] Here, 50 is RAM for being the control section which makes the main-control section of equipment, and storing ROM which stored fixed data, such as a program corresponding to CPU which performs procedure later mentioned per drawing 7, and its procedure, and a table of the temperature data corresponding to the temperature sensor output, and amendment data and others. And it has a power supply unit for energizing at a heater etc. In addition, at this example, it is RAM. It backs up with the battery etc. so that the content may not be lost, even if the power supply of the main part of equipment is off about the content of storage, especially amendment data.

[0024] 51 is the recording head included in the head cartlidge which described drawing 3 and drawing 4. 54 shall consist of the cap equipment which is regurgitation recovery equipment and was formed possible [ a recording head 51, opposite, or junction ] in the home position of the record out of range 51 in drawing 2 or, for example, a recording head, and carriage 15, and the suction mechanism for it being open for free passage to this, and performing ink suction from the ink delivery of a recording head 51.

[0025] 56 is a horizontal-scanning mechanism for making carriage 15 scan on the occasion of record etc., and contains motor 17 grade. 57 is a vertical-scanning mechanism and contains the motor 20 grade which conveys a record medium.

[0026] Drawing 6 shows the detailed example of composition of the principal part in the above composition. Here, temperature sensors, such as a resistor of the meandering configuration by the aluminum to which 51 stated the recording head and 8 already stated a keeping-warm heater and 2, or diode, and 10 are reference supplies. The current IF which 11 is the amplifier for constituting the constant current source which supplies a constant current to a temperature sensor 2, and flows is [0027].

[Equation 1]

$IF = (E/R3) - [R2/(R1+R2)]$  -- It is (1).

[0028] Drawing 7 shows the temperature characteristic at the time of the constant current of diode. The amplifier 9 of the latter part of the amplifier 11 in drawing 6 is the output VA of the preceding paragraph, and a difference with a reference supply  $E R5/R4$  Doubling, the output V0 is [0029].

[Equation 2]

$V0 = E + (R5/R4) - (E - VA)$  -- It is given by (2).

[0030] However, these (1) And (2) A formula is (2), when it is the calculated value in ideal amplifier to the last, offset voltage  $\Delta V$  exists in the amplifier 9 in drawing 6 in fact and this point is taken into consideration. A formula is [0031].

[Equation 3]

$V0 = E + (R5/R4) - (E + \Delta V - VA)$  -- It is set to (3). That is, an output V0 will be influenced only  $-(R5/R4) \Delta V$ , i.e., the gain twice of offset voltage.

[0032] Although it uses the temperature characteristic of the voltage drop of the forward direction of diode in using diode as a temperature sensor, though the rate of change to temperature is the same, dispersion arises by lot dispersion etc.

[0033] As shown in drawing 8, when diode is used as a sensor, it becomes the relation which an output V0 increases linearly with elevation of temperature, and dispersion will be produced with the width of face of  $\Delta V_0$  to an ideal line A in fact. However, in an important point, slope-of-a-line alpha becomes settled with the property of a sensor here, and this value goes into less than 1% of precision in a semiconductor like especially diode.

[0034] Therefore, A/D [ in / predetermined temperature / beforehand / on the temperature control concerning this example, and ] of V0 The conversion value is written in the nonvolatile memory 110 (RAM backed up by the battery), and an exact thermometry can be realized by rectifying a temperature sensor 2 based on this.

[0035] This can be performed as follows, for example.

[0036] For example, the output of the temperature sensor arranged in the proper part of equipment etc. apart from the heater board top is inputted, and ambient temperature T0 is specified. Next, the output (digital value corresponding to V0 specifically received by input edge A/D 3 in drawing 6) of the temperature sensor 2 prepared in the heater board 1 of a recording head 50 is led, and the temperature data corresponding to the output concerned are determined. And the correction value X0 of a sensor 2 is defined from the temperature data determined from the output of both sensors, and it is RAM about this. A store is carried out to a predetermined field. Since the temperature sensor 2 is arranged in one both sides on the heater board 9 each in this example, correction value is determined about each, and it is RAM of drawing 5. Namely, non-volatile memory 110 of drawing 6 A store can be carried out.

[0037] Drawing 9 shows an example of the temperature-control procedure using the correction value obtained as mentioned above. First, step S11 It is the output (input of A/D 3) V0 of amplifier 9 then A/D It changes and is Step S13. From this value (value which changed the input value of A/D 3 A/D), it is non-volatile memory 110 beforehand. The memorized predetermined temperature (T0), for example, A/D at the time of 25 degrees C, A value (input value of A/D 2) X0 is deducted. Output variation C per [ which sets this difference to X and is next equivalent to slope-of-a-line alpha ] temperature of 1 degree C [V/degree C] X is \*\* (ed) and the actual temperature change from predetermined temperature (T0) is computed (Step S15). The temperature T present at the step to the above can be found.

[0038] In this way, if T can be found, ON/OFF of a keeping-warm heater are controllable by performing comparison (Step S17) with the setting temperature T1 (Step S19). And according to this example, such a temperature control will be performed more to accuracy.

[0039] Next, the case where the meandering pattern of aluminum as shown in drawing 4 is used as a sensor is explained.

[0040] It shows the pattern, the resistance in this case becomes settled by the overall length and pattern width of face, and it is [0041]. [ drawing 10 ] [ \*\* ] [ type ]

[Equation 4]

$R = \gamma \cdot (L/W) \quad \text{-- (4)}$

It is come out and given. That is, resistance will be proportional to an overall length and will be in inverse proportion to pattern width of face. gamma is a constant here. Therefore, what is necessary is to devise the pattern for making it function as a sensor, and just to design L and W in this example, so that the value which temperature detection tends to perform may be acquired.

[0042] Drawing 11 shows the temperature characteristic of aluminum. In aluminum, unlike the case of diode, by the constant current F, the voltage drop VF of the increase of resistance, therefore ends goes up in connection with a temperature rise. In this case, although the lower right like drawing 12 serves as a straight line of \*\*, the circuit output V0 inclines and its beta is fixed by the property of aluminum. Therefore, A/D [ in / predetermined temperature (T0) / like the case of the diode sensor mentioned already ] of V0 If the conversion value is written in non-volatile memory, the temperature control which rectified the circuit error by the same control procedure as last time is realizable.

[0043] (in addition to this) In addition, especially this invention is equipped with meanses (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink-jet recording method in order to make the ink regurgitation perform, and brings about the effect which was excellent in the recording head of the method which makes the change of state of ink occur with the aforementioned heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0044] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the foam in the liquid (ink) corresponding to this driving signal can be formed by the one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of this foam, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of a foam will be performed appropriately instantly, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0045] The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to a delivery which is indicated by each above-mentioned specification as composition of a recording head, the liquid route, and the field to which the heat operation section other than the combination composition (a straight-line-like liquid flow channel or right-angled liquid flow channel) of an electric thermal-conversion object is crooked is also included in this invention. In addition, the effect of this invention is effective also as composition based on JP,59-138461,A which indicates the composition whose puncturing which absorbs the pressure wave of JP,59-123670,A

which indicates the composition which makes a common slit the regurgitation section of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to the regurgitation section. That is, it is because it can record efficiently certainly according to this invention no matter the gestalt of a recording head may be what thing.

[0046] Furthermore, this invention is effectively applicable also to the recording head of the full line type which has the length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the composition which fills the length with the combination of two or more recording heads, and the composition as one recording head formed in one are sufficient.

[0047] In addition, this invention is effective when the thing of a serial type like an upper example also uses the recording head fixed to the main part of equipment, the recording head exchangeable chip type to which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained by the main part of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0048] Moreover, it is a book as composition of the recording device of this invention to add the regurgitation recovery means of a recording head, preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0049] moreover, two or more ink which differs in an others and record color or concentration although only one piece was prepared also about the kind or the number of a recording head carried, for example corresponding to monochromatic ink -- corresponding -- two or more pieces -- more than -- it may be prepared That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0050] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [ a room temperature or it ], and what is softened or liquefied at a room temperature may be used. Or by the ink-jet method, since what carries out a temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stable regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid state to the liquid state of ink, or in order to prevent evaporation of ink, you may use the ink which solidifies in the state of neglect and is liquefied by heating. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied when using the ink of the property liquefied for the first time by grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0051] Furthermore, in addition, as a gestalt of this invention ink-jet recording device, although used as the picture outgoing end end of information management systems, such as a computer, you may take the gestalt of the reproducing unit combined with others, the reader, etc., and the facsimile apparatus which has a transceiver function further.

[0052]

[Effect of the Invention] As explained above, according to this invention, the same control as the case where a temperature sensing element expensive [ a highly precise thermistor etc. ] and exact is used is realizable by diode, the meandering pattern of aluminum, etc. being cheap, constituting a temperature sensor, and making non-volatile memory memorize the peculiar property beforehand.

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**TECHNICAL FIELD**

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[Industrial Application] Especially this invention is applied to the fluid injection recording device which comes to use an electric thermal-conversion object for the \*\*\*\* energy generation means of the drop for record about a fluid injection recording device, and is suitable.

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PRIOR ART

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[Description of the Prior Art] Since liquid deliveries, such as an orifice for carrying out the regurgitation of the drop of the liquid for record (ink), can be arranged with high density, this kind of fluid injection recording head can carry out record of high resolution. The progress of technology and the improvement in reliability in that miniaturization overall as a recording head is also easy and the latest semiconductor field can utilize the advantage of remarkable IC technology or micro processing technology more than enough. According to long-picture-izing and shape[ of a field ]-izing (two-dimensional-izing) being easy etc., the formation of a multi-nozzle and high-density-assembly-izing are easy, and, moreover, the productivity at the time of mass production method attracts attention especially as what is improved at a low price by manufacture costs.

[0003] However, this kind of fluid injection recording head has a relation between the diameter of drops of temperature and ink, regurgitation speed, etc., and these affect picture concentration and have the feature of influencing record grace.

[0004] In view of such a point, as conventionally shown in drawing 1, it is a head 201. Highly precise thermistor 203 It prepares and is this thermistor 203. It is a change in resistance A/D, such as a microcomputer 206, A conversion terminal detects and it is a recording head 201. Keeping-warm heater 202 for heating and keeping it warm Power was controlled. In addition, it sets to drawing 1 and is 204. A partial pressure resistor and 205 It is a transistor for a switch for turning on / turning off the keeping-warm heater 2.

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EFFECT OF THE INVENTION

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[Effect of the Invention] As explained above, according to this invention, the same control as the case where a temperature sensing element expensive [ a highly precise thermistor etc. ] and exact is used is realizable by diode, the meandering pattern of aluminum, etc. being cheap, constituting a temperature sensor, and making non-volatile memory memorize the peculiar property beforehand.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, the temperature-control method which requires temperature sensing elements, such as the conventional highly precise thermistor, makes the manufacturing cost of a head expensive, and when considering especially a recording head or the recording head (a head cartlidge is called below) of the form which unified this and the ink source-of-supply slack ink tank as the composition which enabled it to detach and attach easily on the main part of equipment, and made exchange possible, it serves as a trouble.

[0006] Even if a cheap temperature sensor with variation is used for the purpose of this invention in view of this point, it is to enable it to give exact temperature.

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MEANS

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[Means for Solving the Problem] Therefore, this invention is prepared corresponding to the delivery and this delivery of the \*\* sake which breathes out record liquid, and is characterized by a fluid injection recording device with the removable recording head which has the energy generation element which generates the energy used for the \*\* sake which breathes out the aforementioned record liquid, and a temperature sensing element for detecting temperature possessing the following. A nonvolatile storage means to hold the property of the aforementioned temperature sensing element. An amendment means to rectify the detection output of the aforementioned temperature sensing element based on the property concerned.

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**OPERATION**

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[Function] In this invention, in case cheap things, such as meandering patterns, such as comparatively large aluminum of resistance rate of change, are prepared in the temperature sensing element of a head to diode or a temperature change and the temperature control of a head is performed using the temperature characteristic of such an element, the temperature detector writes beforehand the variation which it has peculiar in non-volatile memory, and rectifies the detection output of a temperature sensing element based on this. Therefore, it becomes possible to abolish the error of temperature detection.

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## EXAMPLE

[Example] Hereafter, with reference to a drawing, this invention is explained in detail.

[0010] The example of composition of the fluid injection recording device (ink-jet recording device) which drawing 2 requires for the 1st example of this invention, and drawing 3 are the example of composition of the recording head, and drawing 4 (a). And (b) The example of composition of a heater board employable as a component of the recording head shown in drawing 3 is shown.

[0011] First, in drawing 2, 14 is a head cartlidge and makes one the recording head constituted using the heater board later mentioned per drawing 3 and drawing 4, and an ink source-of-supply slack ink tank. This head cartlidge 14 presses down, and is being fixed by the member 41 on carriage 15, and these can reciprocate to a longitudinal direction along with a shaft 21. The ink breathed out from the recording head sets a recording head and a very small interval, reaches the record medium 18 which had the recording surface regulated by the platen 19, and forms a picture on a record medium 18.

[0012] The regurgitation signal according to image data is supplied to a recording head from a proper data source of supply through the terminal 4 (drawing 4) combined with a cable 16 and this. A head cartlidge can prepare 1 or plurality (drawing two pieces) according to the ink color to be used.

[0013] In addition, in drawing 2, the carriage motor for 17 making carriage 15 scan along with a shaft 21 and 22 are wires which transmit the driving force of a motor 17 to carriage 15. Moreover, 20 is a feed motor for combining with a platen roller 19 and making a record medium 18 convey. Moreover, 122 It is a reference-temperature sensor used as the criteria for being prepared in a part with the proper main part of equipment, and rectifying the temperature sensor mentioned later. This reference-temperature sensor 122 It is arranged at the proper part which is not influenced of a temperature up inside the plane, and the monitor of the ambient temperature is carried out.

[0014] Drawing 3 is the example of composition of the recording head concerning this example. Here, 1 is a heater board, and on a silicon substrate, the electric thermal-conversion object (\*\*\*\* heater) 5 and the wiring 6 of aluminum which supplies power to this are formed by membrane formation technology, and it changes. And a fluid injection recording head is constituted by pasting up the top plate 30 which prepared the septum for forming the liquid route (nozzle) 25 of the liquid for record to this heater board 1.

[0015] The liquid for record (ink) is supplied to the common liquid room 23 from the feed hopper 24 prepared in the top plate 30, and is led in each nozzle 25 here. And if a heater 5 generates heat by energization, foaming will arise in the ink filled in the nozzle 29, and an ink drop will be breathed out from a delivery 26.

[0016] Drawing 4 (a) And (b) They are the plan of the heater board concerning this example, and its elements on larger scale, respectively.

[0017] This drawing (a) Setting, 3 is the \*\*\*\* heater section. 4 is a terminal and is connected with the exterior by wirebonding. 2 is a temperature detection means slack temperature sensor, and is formed in the \*\*\*\* heater section 3 according to the same membrane formation process as \*\*\*\* heater section 3 grade. This drawing (b) This drawing (a) It is the enlarged view of the portion B containing the sensor 2 which can be set, and 8 is a heating means slack keeping-warm heater for heating a head.

[0018] Like other portions, since the sensor 2 is formed according to the same membrane formation process as a semiconductor, it is very highly precise, and it can be created with material from which conductivity changes according to temperature, such as aluminum which is the component of other portions, titanium, a tantalum, 5 tantalum oxide, and niobium. For example, the material and the tantalum which can be arranged among both among these in order that the material which can use aluminum for an electrode, and titanium may raise the adhesive property of the exoergic resistive layer and electrode which constitute an electric thermal-conversion element are the material which can be arranged in the upper part, in order to raise the cavitation-proof nature of the protective layer on an exoergic resistive layer. Moreover, in order to make line breadth thick in order to make variation in a process into smallness, and to lessen influence of wiring resistance etc., high resistance-ization is attained as a meandering configuration.

[0019] Moreover, the keeping-warm heater 8 is the same material (for example, HfB<sub>2</sub>) as the exoergic resistive layer of the \*\*\*\* heater 5 similarly. Although it can use and form, you may form using the other materials which constitute a heater board, for example, aluminum, a tantalum, titanium, etc.

[0020] Next, the mode of the temperature control of the recording head concerning this example is explained.

[0021] In the recording head shown in drawing 3 concerning this example, since the temperature sensor 2 is provided in the ends of the heater board 1 as shown in drawing 4, the distribution state of the substrate temperature in the array direction of a nozzle 25 can be grasped from the output of those temperature sensors. Moreover, since the heater 8 for keeping warm is formed near the temperature sensor 2, the speed of response of detection of change of the temperature by heating is high.

[0022] Drawing 5 shows the outline of the example of 1 composition of the control system concerning this example.

[0023] Here, 50 is RAM for being the control section which makes the main-control section of equipment, and storing ROM which stored fixed data, such as a program corresponding to CPU which performs procedure later mentioned per drawing 7, and its procedure, and a table of the temperature data corresponding to the temperature sensor output, and amendment data and others. And it has a power supply unit for energizing at a heater etc. In addition, at this example, it is RAM. It backs up with the battery etc. so that the contents may not be lost, even if the power supply of the main part of equipment is off about

the contents of storage, especially amendment data.

[0024] 51 is the recording head included in the head cartridge which described drawing 3 and drawing 4. 54 shall consist of the cap equipment which is \*\*\*\* recovery equipment and was formed possible [ a recording head 51, opposite, or junction ] in the home position of the record out of range 51 in drawing 2 or, for example, a recording head, and carriage 15, and the suction mechanism for it being open for free passage to this, and performing ink suction from the ink delivery of a recording head 51.

[0025] 56 is a horizontal-scanning mechanism for making carriage 15 scan on the occasion of record etc., and contains motor 17 grade. 57 is a vertical-scanning mechanism and contains the motor 20 grade which conveys a record medium.

[0026] Drawing 6 shows the detailed example of composition of the principal part in the above composition. Here, temperature sensors, such as a resistor of the meandering configuration by the aluminum to which 51 stated the recording head and 8 already stated a keeping-warm heater and 2, or diode, and 10 are reference supplies. The current IF which 11 is the amplifier for constituting the constant current source which supplies a constant current to a temperature sensor 2, and flows is [0027].

[Equation 1]

$IF = (E/R3) - [R2/(R1+R2)]$  -- It is (1).

[0028] Drawing 7 shows the temperature characteristic at the time of the constant current of diode. The amplifier 9 of the latter part of the amplifier 11 in drawing 6 is the output VA of the preceding paragraph, and a difference with a reference supply E  $R5/R4$  Doubling, the output V0 is [0029].

[Equation 2]

$V0 = E + (R5/R4) - (E - VA)$  -- It is given by (2).

[0030] However, these (1) And (2) A formula is (2), when it is the calculated value in ideal amplifier to the last, offset voltage  $\Delta V$  exists in the amplifier 9 in drawing 6 in fact and this point is taken into consideration. A formula is [0031].

[Equation 3]

$V0' = E + (R5/R4) - (E + \Delta V - VA)$  -- It is set to (3). That is, an output V0 will be influenced only  $-(R5/R4) \Delta V$ , i.e., the gain twice of offset voltage.

[0032] Although it uses the temperature characteristic of the voltage drop of the forward direction of diode in using diode as a temperature sensor, though the rate of change to temperature is the same, dispersion arises by lot dispersion etc.

[0033] As shown in drawing 8, when diode is used as a sensor, it becomes the relation which an output V0 increases linearly with the rise of temperature, and dispersion will be produced with the width of face of  $\Delta V0$  to an ideal line A in fact.

However, in an important point, slope-of-a-line alpha becomes settled with the property of a sensor here, and this value goes into less than 1% of precision in a semiconductor like especially diode.

[0034] Therefore, A/D [ in / predetermined temperature / beforehand / on the temperature control concerning this example, and ] of V0 The conversion value is written in the nonvolatile memory 110 (RAM backed up by the battery), and an exact thermometry can be realized by rectifying a temperature sensor 2 based on this.

[0035] This can be performed as follows, for example.

[0036] For example, the output of the temperature sensor arranged in the proper part of equipment etc. apart from the heater board top is inputted, and ambient temperature T0 is specified. Next, the output (digital value corresponding to V0 specifically received by input edge A/D 3 in drawing 6) of the temperature sensor 2 prepared in the heater board 1 of a recording head 50 is led, and the temperature data corresponding to the output concerned are determined. And the correction value X0 of a sensor 2 is defined from the temperature data determined from the output of both sensors, and it is RAM about this. A store is carried out to a predetermined field. Since the temperature sensor 2 is arranged in one both sides on the heater board 9 each in this example, correction value is determined about each, and it is RAM of drawing 5. Namely, non-volatile memory 110 of drawing 6 A store can be carried out.

[0037] Drawing 9 shows an example of the temperature-control procedure using the correction value obtained as mentioned above. First, step S11 It is the output (input of A/D 3) V0 of amplifier 9 then A/D It changes and is Step S13. From this value (value which changed the input value of A/D 3 A/D), it is non-volatile memory 110 beforehand. The memorized predetermined temperature (T0), for example, A/D at the time of 25 degrees C, A value (input value of A/D 2) X0 is deducted. Output variation C per [ which sets this difference to X and is next equivalent to slope-of-a-line alpha ] temperature of 1 degree C [V/degree C] X is \*\* (ed) and the actual temperature change from predetermined temperature (T0) is computed (Step S15). The temperature T present at the step to the above can be found.

[0038] In this way, if T can be found, ON/OFF of a keeping-warm heater are controllable by performing comparison (Step S17) with the setting temperature T1 (Step S19). And according to this example, such a temperature control will be performed more to accuracy.

[0039] Next, the case where the meandering pattern of aluminum as shown in drawing 4 is used as a sensor is explained.

[0040] It shows the pattern, the resistance in this case becomes settled by the overall length and pattern width of face, and it is [0041]. [ drawing 10 ] [ \*\* ] [ type ]

[Equation 4]

$R = \gamma \cdot (L/W)$  -- (4)

It is come out and given. That is, resistance will be proportional to an overall length and will be in inverse proportion to pattern width of face. gamma is a constant here. Therefore, what is necessary is to devise the pattern for making it function as a sensor, and just to design L and W in this example, so that the value which temperature detection tends to perform may be acquired.

[0042] Drawing 11 shows the temperature characteristic of aluminum. In aluminum, unlike the case of diode, by the constant current F, the voltage drop VF of the increase of resistance, therefore ends goes up in connection with a temperature rise. In this case, although the lower right like drawing 12 serves as a straight line of \*\*, the circuit output V0 inclines and its beta is fixed by the property of aluminum. Therefore, A/D [ in / predetermined temperature (T0) / like the case of the diode sensor mentioned already ] of V0 If the conversion value is written in non-volatile memory, the temperature control which rectified the circuit error by the same control procedure as last time is realizable.

[0043] (in addition to this) In addition, especially this invention is equipped with meanses (for example, an electric

thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an ink-jet recording method in order to make ink \*\*\*\* perform, and brings about the effect which was excellent in the recording head of the method which makes the change of state of ink occur with the aforementioned heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0044] About the typical composition and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called on-demand type and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the on-demand type case By impressing at least one driving signal which gives the rapid temperature rise which corresponds to recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the air bubbles in the liquid (ink) corresponding to this driving signal can be formed by the one to one as a result, it is effective. A liquid (ink) is made to breathe out through \*\*\*\*\* opening by growth of these air bubbles, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of air bubbles will be performed appropriately instantly, \*\*\*\* of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0045] The composition using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the composition arranged to a delivery which is indicated by each above-mentioned specification as composition of a recording head, the liquid route, and the field to which the heat operation section other than the combination composition (a straight-line-like liquid-flow channel or right-angled liquid-flow channel) of an electric thermal-conversion object is crooked is also included in this invention. In addition, the effect of this invention is effective also as composition based on JP,59-138461,A which indicates the composition whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the composition which makes a common slit the regurgitation section of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to the regurgitation section. That is, it is because it can record efficiently certainly according to this invention no matter the gestalt of a recording head may be what thing.

[0046] Furthermore, this invention is effectively applicable also to the recording head of the full line type which has the length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the composition which fills the length with the combination of two or more recording heads, and the composition as one recording head formed in one are sufficient.

[0047] In addition, this invention is effective when the thing of a serial type like an upper example also uses the recording head fixed to the main part of equipment, the recording head exchangeable chip type to which the electric connection with the main part of equipment and supply of the ink from the main part of equipment are attained by the main part of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0048] Moreover, it is a book as composition of the recording device of this invention to add the regurgitation recovery means of a recording head, preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and a reserve regurgitation means to perform the regurgitation different from record can be mentioned.

[0049] moreover, two or more ink which differs in an others and record color or concentration although only one piece was prepared also about the kind or the number of a recording head carried, for example corresponding to monochromatic ink -- corresponding -- two or more pieces -- more than -- it may be prepared That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0050] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [ a room temperature or it ], and what is softened or liquefied at a room temperature may be used. Or by the ink-jet method, since what carries out a temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stable regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid state to the liquid state of ink, or in order to prevent evaporation of ink, you may use the ink which solidifies in the state of neglect and is liquefied by heating. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied when using the ink of the property liquefied for the first time by grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a breakthrough which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the state where it was held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0051] Furthermore, in addition, as a gestalt of this invention ink-jet recording device, although used as the picture outgoing end end of information management systems, such as a computer, you may take the gestalt of the reproducing unit combined with others, the reader, etc., and the facsimile apparatus which has a transceiver function further.

[0052]



[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] They are explanatory drawings, such as the conventional temperature control.

[Drawing 2] It is the perspective diagram showing the example of composition of the ink-jet recording device concerning the example of this invention.

[Drawing 3] It is the perspective diagram showing the example of composition of the recording head.

[Drawing 4] Drawing 4 (a) And (b) It is the perspective diagram showing the example of 1 composition of a heater board applicable to the recording head of the 2nd illustration.

[Drawing 5] It is the block diagram showing the example of outline composition of the control system of the equipment concerning this example.

[Drawing 6] It is the block diagram showing the detailed example of composition of the principal part.

[Drawing 7] It is explanatory drawing showing the temperature characteristic of the diode which can be used as a temperature sensor.

[Drawing 8] It is explanatory drawing showing the circuit output characteristics.

[Drawing 9] It is the flow chart which shows an example of the temperature-control procedure of this example.

[Drawing 10] It is explanatory drawing showing the temperature characteristic of the resistor pattern of the aluminum which can be used as a temperature sensor.

[Drawing 11] It is explanatory drawing for explaining the circuit output characteristics.

[Drawing 12] It is the \*\* type view of the resistor pattern of the aluminum.

[Description of Notations]

- 1 Heater Board
- 2 Temperature Sensor
- 3 Regurgitation Heater Section
- 5 Regurgitation Heater
- 8 Keeping-Warm Heater
- 9 Resistor
- 14 Head Cartlidge
- 50 Control Section
- 51 Recording Head

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[Translation done.]

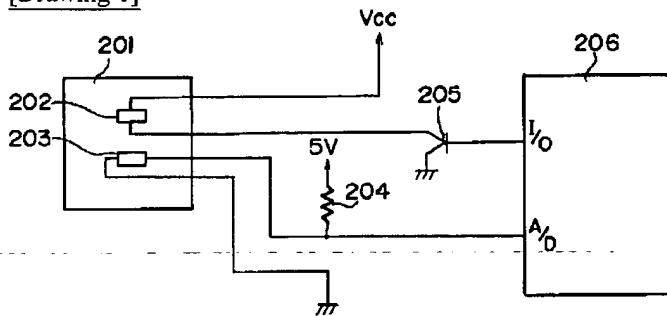
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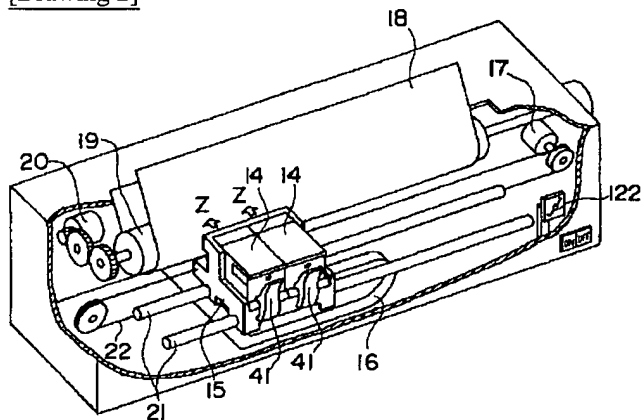
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DRAWINGS

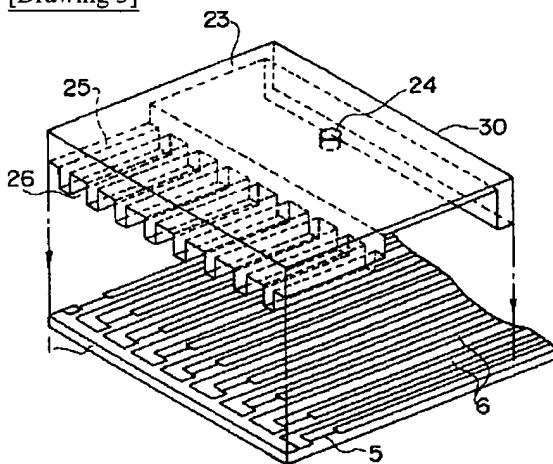
[Drawing 1]



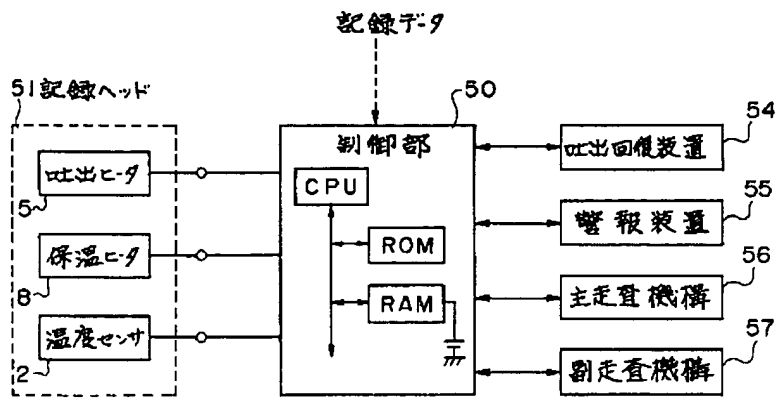
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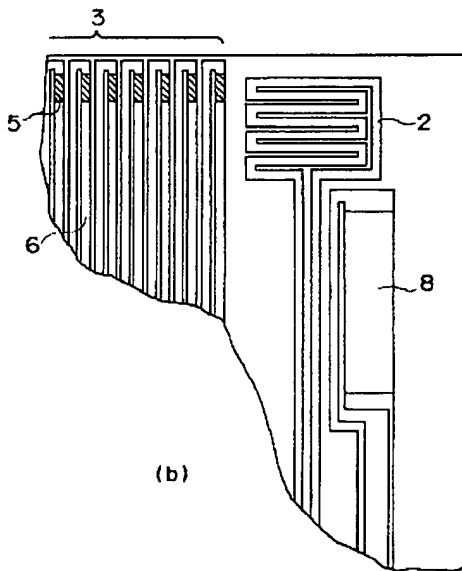
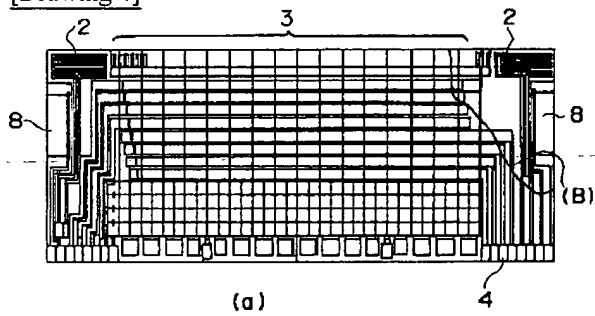
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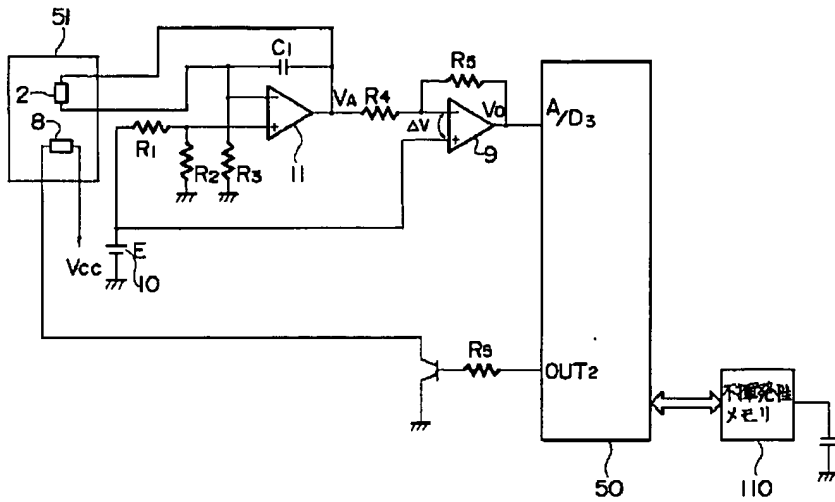
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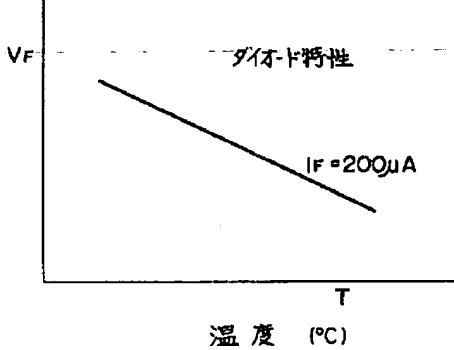
[Drawing 4]



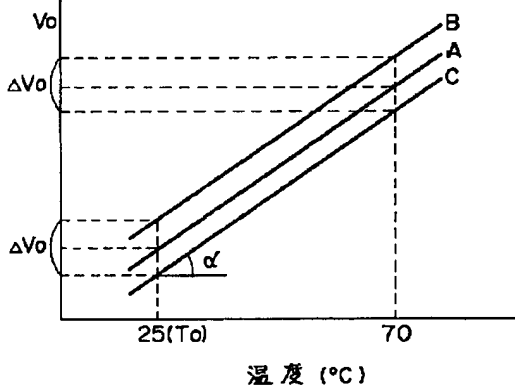
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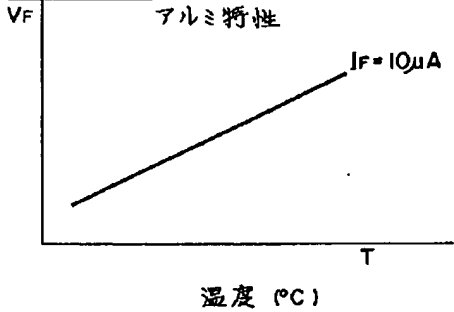
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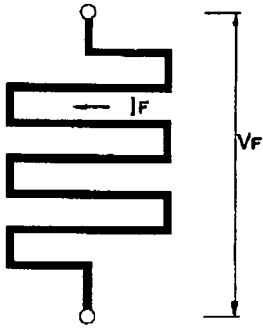
[Drawing 8]



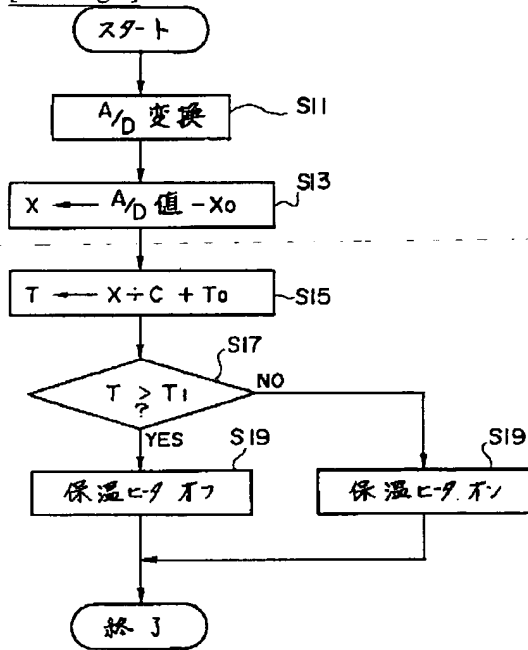
[Drawing 10]



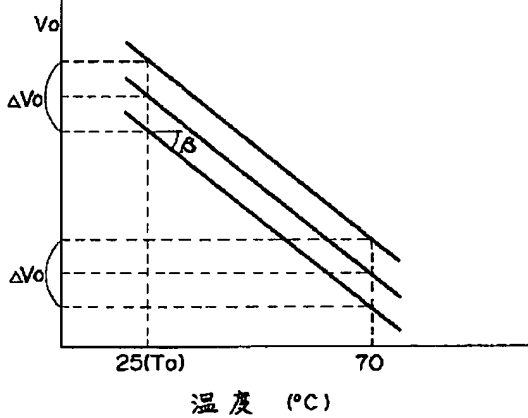
[Drawing 12]



[Drawing 9]



[Drawing 11]



[Translation done.]